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Consequences of Cervical Spine Immobilization in Prehospital Trauma Patients

By

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Abstract

Immobilizing the cervical spine is the standard of care in the United States to prevent exacerbating unstable spinal fractures resulting in permanent neurological deficits. Current spinal protocols liberally place collars on trauma patients although retrospective studies on these guidelines have revealed multiple negative consequences of prolonged scene times and immobilization on patient outcomes. There are limited studies in the United States about the consequences of not taking spinal precautions because there is a fear of not immobilizing a patient and causing permanent neurologic deficits. However, the few studies that are available demonstrate that collars are not beneficial. Spinal protocols should attempt to target unstable spinal fractures and research should continue to analyze the effectiveness of protocols until cervical spine precautions are standardized and supported by evidence-based medicine.

Introduction

Spinal immobilization is a precaution implemented with the intent to prevent secondary spinal injury. Although immobilization has become the hallmark of prehospital care, the current evidence that supports the liberal application of cervical spine collars is of low quality.¹ All prehospital spine immobilization guidelines given by the American Association for Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS) Joint Guidelines committee are level III recommendations. Because of the devastating negative consequences of exacerbating an unstable fracture resulting in permanent neurological deficits, immobilization guidelines have sacrificed specificity to increase the sensitivity of immobilizing unstable fractures. However, now there is growing evidence that cervical collars can have adverse effects.

It should be noted that there are multiple spinal immobilization protocols that lack standardization and vary by region. The Prehospital Trauma Life Support Protocol (PHTLS) is based on the mechanism of injury, and Domeier and Hankins, which are similar to the criteria for the National Emergency X-Radiography Utilization Study (NEXUS) criteria.² The NEXUS and Canadian cervical-spine rules are great tools that aid in the decision of whether to image the cervical spine in the emergency department to detect all cervical spine fractures. However, stable spinal fractures are not as critical to identify and immobilize in the prehospital setting and the ideal protocol would aim at detecting unstable injuries that may worsen during transport. In 2015 the Central California Emergency Medical Services Agency (CCEMSA) created a new spinal immobilization protocol. It appears that this new guideline attempts to accomplish the goal of decreasing the use of spinal immobilization while still immobilizing unstable injuries. (Full cervical spine protocols are listed in the appendix).

Currently, immobilization guidelines are at the discretion of the EMS director because high-quality evidence is limited. The goal should be to place cervical collars only when necessary, however, there is no solid evidence on how to target patients with unstable fractures. This paper investigates how placing a cervical collar compared to leaving the spine unprotected affects the overall outcome in patients sustaining a traumatic injury from time of EMS evaluation to discharge.

Discussion

Trauma patients are being over immobilized

Cervical spinal immobilization guidelines encompass many trauma patients in attempts to increase the sensitivity for unstable cervical spine fractures. However, this raises the question, are patients being over immobilized and what are the negative consequences for over immobilization? In a cross-sectional study of the Prehospital Trauma Life Support (PHTLS) cervical immobilization guidelines, the number of patients with spinal injuries were then cross-referenced with the amount of patients who had met the immobilization criteria to analyze if spinal injuries were being missed.² The primary objective was to determine the proportion of patients who required cervical spine immobilization, based on each protocol's criteria. The secondary objective was to determine the percentage of missed cervical spine injuries had each protocol been followed with 100% compliance.² This study found that mechanism-based PHTLS criteria may result in unnecessary cervical spine immobilization without apparent benefit to injured patients. PHTLS criteria may also be more difficult to implement due to the subjective interpretation of the severity of the mechanism, leading to non-compliance and missed injury.²

EMS personnel have been trained to place patients with gunshot wounds to the head in collars because of the theory that these patients may have incurred cervical spine injuries from the blast of the gunshot or from falling to the ground after the injury.³ However, in a retrospective study of 215 patients with gunshot wounds to the head between July 1, 1990, and September 30, 1995 at Fresno Community Hospital, a level one trauma center, Dr. Kaups and Dr. Davis found zero patients with blast effect, or indirect ligamentous cervical spine injury from a gunshot wound to the head. This study concludes that if the entrance and exit wound can be seen then a collar is not necessary.³

Over immobilizing results in multiple negative consequences

As multiple studies have demonstrated that patients are being over immobilized, direct medical consequences should be discussed. The time it takes to mobilize and transport a patient with cervical spine precautions prolongs scene times and delays hospital care.⁴ In a study of 164,471 patients transported by EMS in the Pennsylvania trauma registry between 2000-2013 prolonged scene times were found to be associated with increased mortality in both blunt and penetrating injuries. Patients who were particularly at risk of fatality were those with hypotension, penetrating injury, and flail chest. Therefore, holding midline should not be prioritized over prolonged scene times, especially in the specific injuries previously discussed.⁴ A systematic review of the literature using a Cochrane style systematic review and meta-analysis looking for mortality outcomes and neurologic deficits concluded that trauma patients are being over immobilized.⁵ This analysis determined that there is no benefit to spinal immobilization even for patients with direct neck injury and suggest that immobilization should not be used for penetrating trauma patients.⁵

Cervical spine immobilization can impair the most important aspect in the mantra of trauma care, the airway. Cervical spine immobilization has been shown to increase failed intubation attempts. Semi-rigid cervical collars significantly reduce the mouth opening.⁶ Rigid collars make intubation the most difficult but even manually holding the head in mid-in-line stabilization increases the intubation failure rate.⁷ Patients who are immobilized in a supine position are also more likely to vomit and/or aspirate.⁶ Cervical collars can also directly impair breathing as one study showed a decrease of 17% in respiratory function in healthy volunteers.⁸

It should be noted that cervical immobilization keeps the head and neck in a “neutral” position however this may not be appropriate for all ages/injuries. For example, in the elderly,

development of excessive thoracic kyphosis, and therefore midline stabilization, may lead to excessive neck extension when positioned on a flat board.⁹ Rigid cervical collars have also been shown to increase intracranial pressure (ICP).¹⁰ The application of a rigid cervical collar causes a small sustained rise in ICP in patients with a traumatic brain injury (TBI). This small rise in pressure is unlikely to be of clinical significance in the majority of patients and cardiopulmonary pressures were not affected by the collar. However, the higher the baseline ICP the more the intracranial pressure increased so collars are more likely to cause problems in patients who are at the highest risk of neurological deterioration. Therefore, as soon as a neck injury is excluded the collar should be removed from a patient with a traumatic brain injury.¹⁰

Immobilizing less is beneficial

If fewer patients were immobilized would we miss unstable fractures leading to permanent neurological deficits and other irreversible negative consequences? This question is difficult to research as the standard of care is to immobilize. Leaving the neck unprotected in an experiment or randomized control trial would possibly be placing the patient at risk for a permanent neurological deficit. There are a few studies however that suggest that no harm will be done to the patient if we don't immobilize. In the United States, a retrospective study was performed on patients who underwent emergent intubation and then were subsequently found to have a spinal injury. These patients were evaluated for signs of worsening neurological deficits. It was concluded that patients with undiagnosed cervical spine injuries can be safely intubated.¹¹

Another study examined the effect of emergency immobilization on neurologic outcomes of patients who had traumatic spinal injuries by comparing the neurological outcomes of patients in Malaysia (all who did not receive out hospital spinal immobilization) to the outcomes of

patients in the US (all who did receive spinal immobilization). Patients in Malaysia who did not receive prehospital care had less neurologic disabilities when compared to similar trauma patients in the US who were all stabilized and transported with EMS trained to immobilize the C spine.¹² This study concluded that the risk of disability was higher for patients in the United States and that there is a 98% probability that immobilization is harmful or of no value.¹²

It should be noted that retrospective research can show more data reflecting the negative consequences of placing the cervical collar because currently, the liberal application of the cervical collar is the standard of care across the united states. To demonstrate that it is safe to transport patients without cervical collars the guidelines would have to reflect strict criteria for collar placement. Currently, there is not enough evidence-based medicine to confidently target unstable spinal fractures. Placing the collar has many small side effects however not placing a collar has the risk of permanent neurological deficits.

Conclusion

In conclusion, limiting spinal mobility to prevent secondary spinal injury has many potential complications. As previously discussed, the collar makes intubation more difficult, increases aspiration risk, decreases respiratory function, and increases intracranial pressure. We place all patients in the same neutral head position; however, collars are not optimized for the individual patient and may place the elderly into hyperextension. There is limited research in the United States that investigates what the consequences would be of leaving the cervical spine unprotected. This is because immobilizing patients in randomized control trials would be an ethical issue as mobilizing is the standard of care and raises the concern of the risk of a

permanent neurological deficit. Evidence suggests that spinal collars should not be liberally applied to all trauma patients, instead each patient should be viewed individually and holistically.

Currently, protocol varies by region and the guidelines are at the discretion of the EMS director. The protocols in place should be further studied to assure the appropriate number of patients are being stabilized and that unstable fractures are not being missed. If these studies continue to find that patients are being over immobilized, then the guidelines can be adjusted to target specific patients with increased risk of unstable injuries. This will be a lengthy process, however standardization and research on protocols would result in safer evidence-based practice.

Appendix

Spinal immobilization protocol prior to 2015:

Implement spinal immobilization in the following circumstances:

- Posterior midline spine pain or tenderness with a history of, or suspicion of trauma
- Injuries distracting patient from distinguishing spinal pain (e.g. pelvic fracture, multisystem trauma, crush injury to the hands or feet, long bone fracture proximal to the knee/elbow or to the humerus/femur)
- Severe head or facial trauma
- Numbness or weakness in any extremity after trauma
- Loss of consciousness secondary to trauma
- If altered mental status (including drugs, alcohol and trauma) and:
 - No history available
 - Found in the setting of possible trauma (e.g. lying at bottom of stairs or in the street) or

- Near drowning with a history of probability of diving injury

CCEMSA Spinal immobilization protocol implemented January 1, 2015

1. Ambulatory Patients:

a. Ambulatory patients without neurological signs or symptoms, without complaints of neck/back pain, and without neck/back tenderness to palpation should be transported in position of comfort.

b. Ambulatory patients with complaints of neck /back pain, or neck/back tenderness, without neurological signs or symptoms, should be transported on a gurney in position of comfort. Their neck/back can be supported as needed.

c. Ambulatory patients with neurological signs or symptoms after trauma, or suspected trauma, need full spinal precautions.

2. Non-Ambulatory Patients:

a. Non-ambulatory patients without neurological signs or symptoms, without complaints of neck/back pain, and without neck/back tenderness to palpation should be transported in position of comfort.

b. Non-ambulatory patients with complaints of neck /back pain, or neck/back tenderness, without neurological signs or symptoms, should be transported on a gurney in a supine position. Their neck/back must be supported until placed on the gurney (manual, KED). Once on the

gurney, their neck/back can be supported as needed.

c. Non-ambulatory patients with neurological signs or symptoms after trauma, or suspected trauma, need full spinal precautions.

d. Non-ambulatory patients with an altered mental status should be transported in full spinal/back precautions.

3. Severe Blunt Multisystem Trauma:

a. Patients with severe blunt multisystem trauma should be transported using KED, breakaway flat, or backboard to expedite bed transfers in severely injured patients.

4. Penetrating Trauma

a. If both blunt and penetrating trauma occur, manage as if severe blunt multi-system trauma.

Table for 2015 protocol

	No neck pain/tenderness	Neck pain/tenderness	Neurologic signs/symptoms	Altered mental status
Ambulatory	Position of comfort	Gurney supine position of comfort with/without support	Full	Position of comfort

Non-ambulatory	Position of comfort	Gurney supine position of comfort with extrication support	Full	Full
Severe Blunt Multisystem Trauma	Full	Full	Full	Full
Penetrating trauma	Position of comfort	Gurney supine position of comfort with extrication support	Full	Full

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